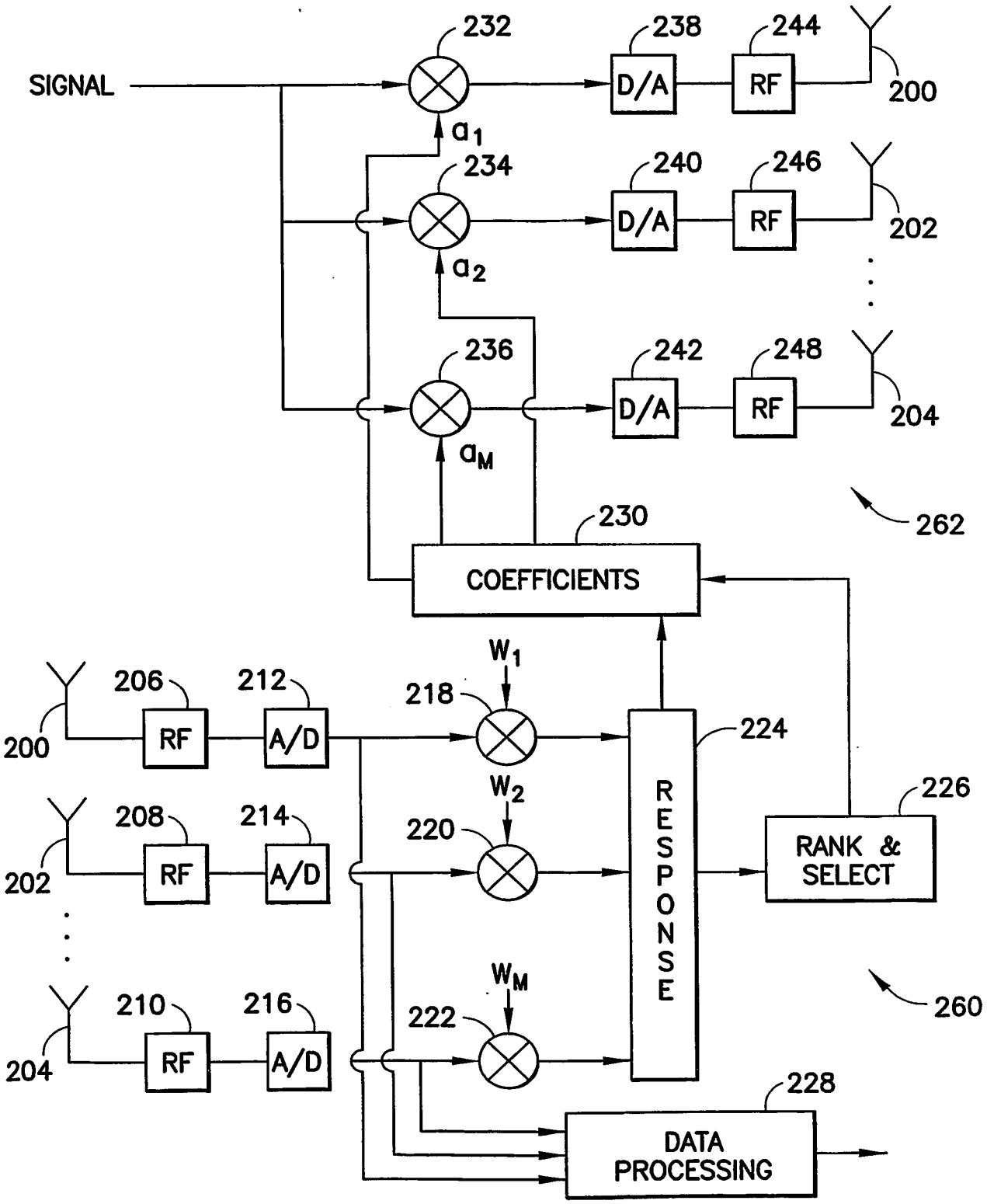
SIGNAL
232
238
244
D/A
RF
200
a_1
234
240
246
D/A
RF
202
a_2
236
242
248
D/A
RF
204
a_M
262
230
COEFFICIENTS
206
212
RF
A/D
200
W_1
218
224
208
214
RF
A/D
202
W_2
220
226
RANK & SELECT
RESPONSE
210
216
RF
A/D
204
W_M
222
260
228
DATA PROCESSING

FIG. 1

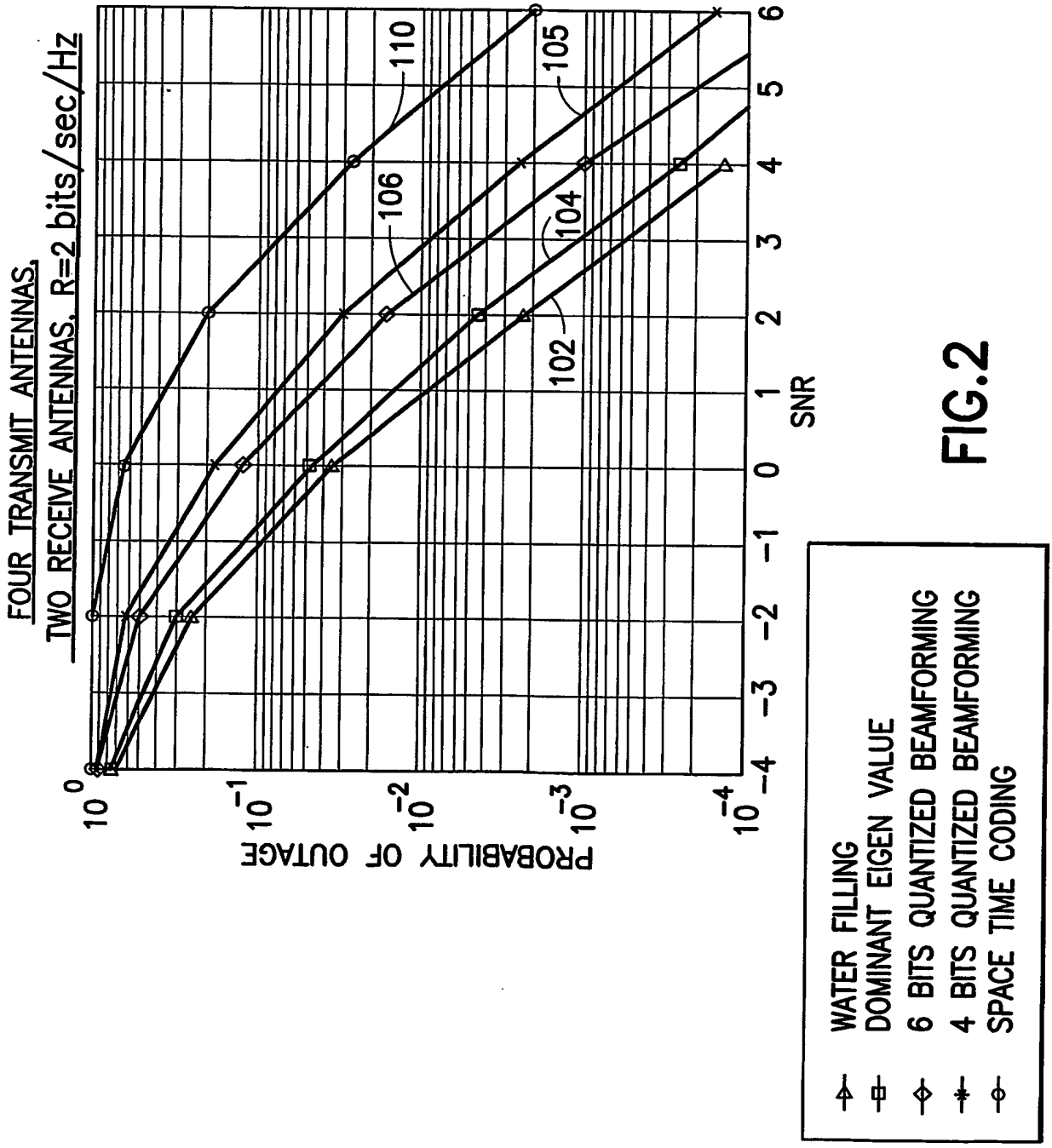
FOUR TRANSMIT ANTENNAS,
TWO RECEIVE ANTENNAS, R=2 bits/sec/Hz
PROBABILITY OF OUTAGE
SNR
110
105
106
104
102
WATER FILLING
DOMINANT EIGEN VALUE
6 BITS QUANTIZED BEAMFORMING
4 BITS QUANTIZED BEAMFORMING
SPACE TIME CODING

FIG.2

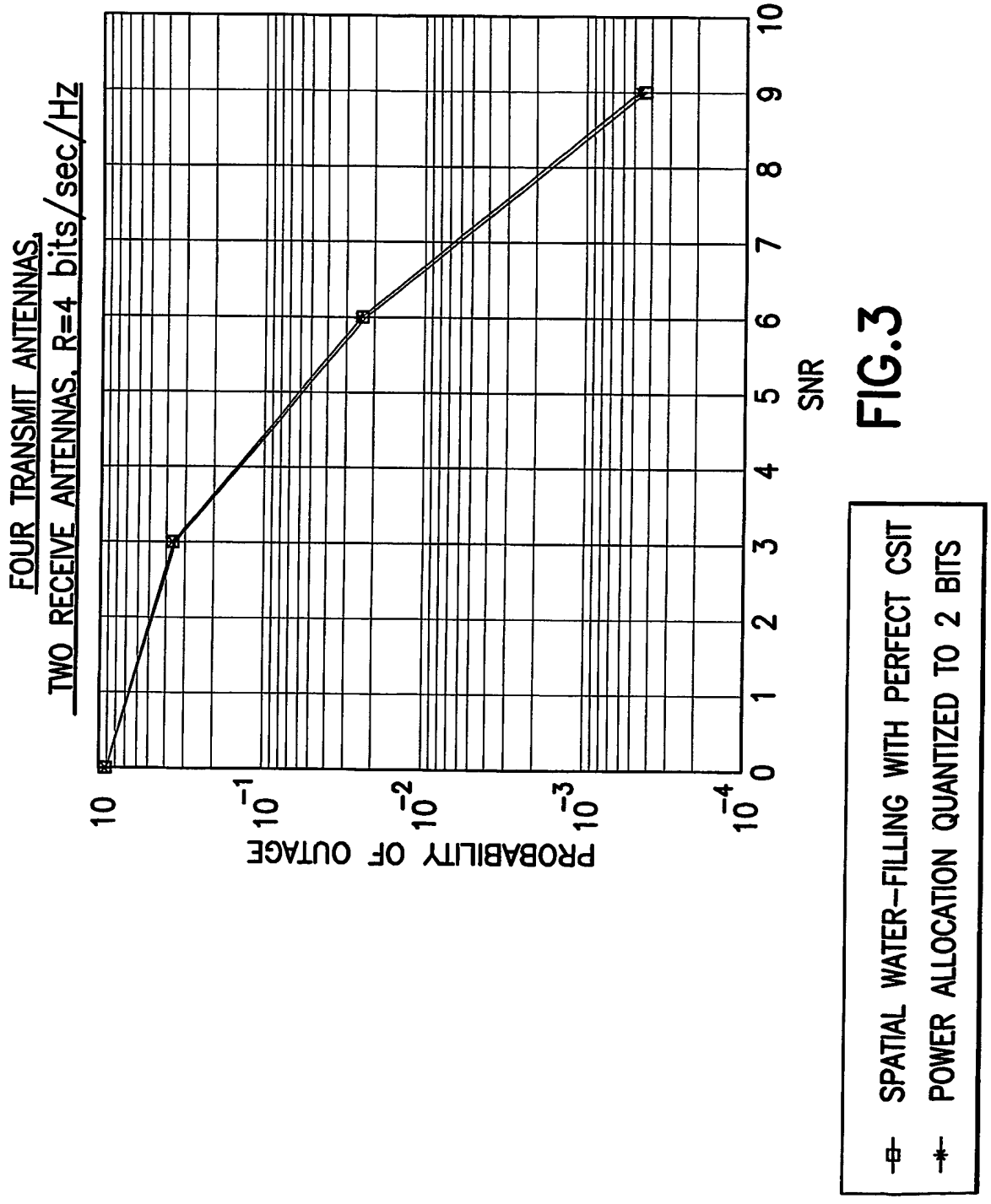
FOUR TRANSMIT ANTENNAS,
TWO RECEIVE ANTENNAS, R=4 bits/sec/Hz
PROBABILITY OF OUTAGE
10
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0 1 2 3 4 5 6 7 8 9 10
SNR
SPATIAL WATER-FILLING WITH PERFECT CSIT
POWER ALLOCATION QUANTIZED TO 2 BITS

FIG.3

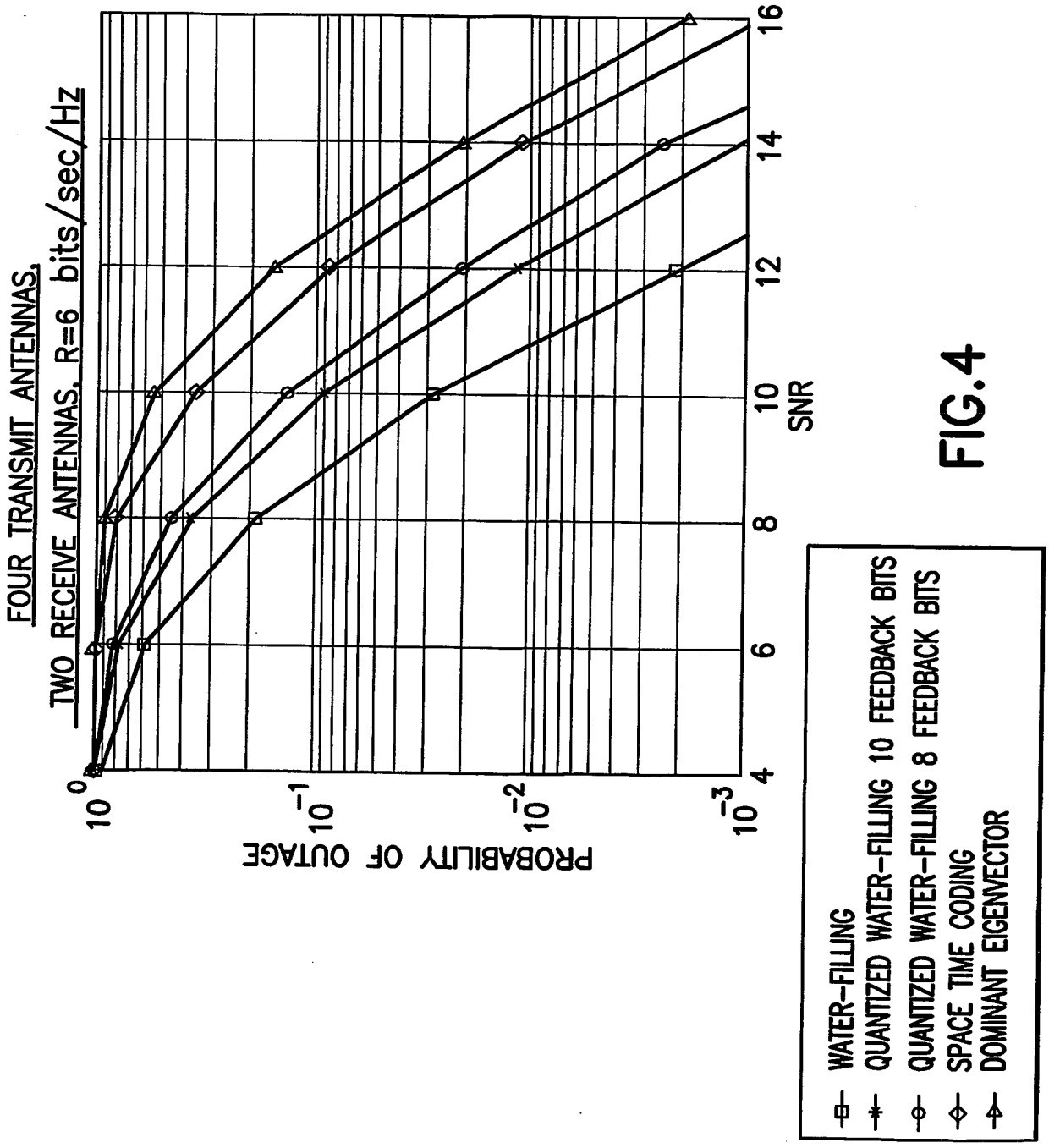
FOUR TRANSMIT ANTENNAS,
TWO RECEIVE ANTENNAS, R=6 bits/sec/Hz
PROBABILITY OF OUTAGE
SNR
10^{0}
10^{-1}
10^{-2}
10^{-3}
4
6
8
10
12
14
16
WATER-FILLING
QUANTIZED WATER-FILLING 10 FEEDBACK BITS
QUANTIZED WATER-FILLING 8 FEEDBACK BITS
SPACE TIME CODING
DOMINANT EIGENVECTOR

FIG.4

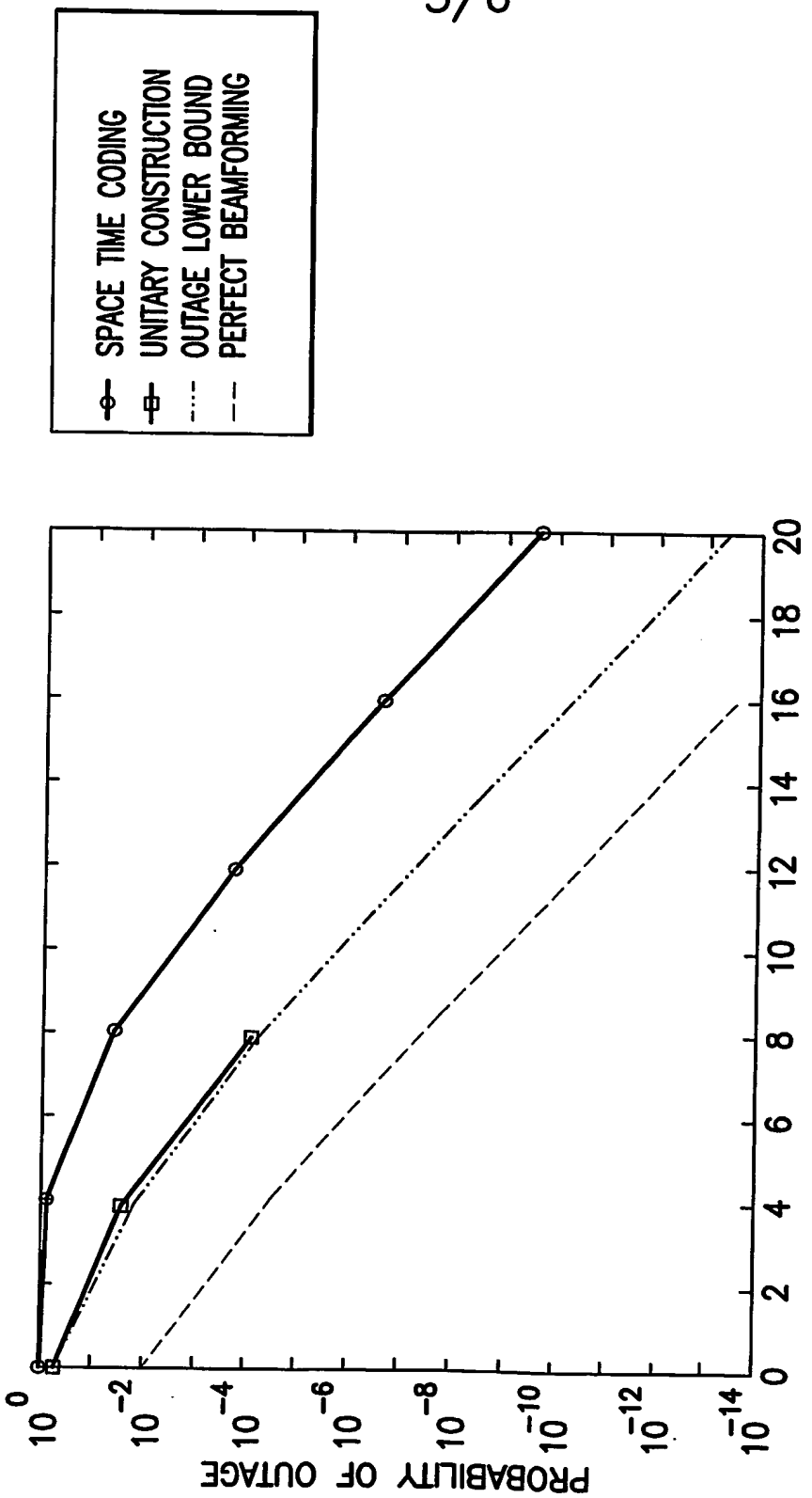
SPACE TIME CODING
UNITARY CONSTRUCTION
OUTAGE LOWER BOUND
PERFECT BEAMFORMING
PROBABILITY OF OUTAGE
SNR
10^0
10^-2
10^-4
10^-6
10^-8
10^-10
10^-12
10^-14
0
2
4
6
8
10
12
14
16
18
20

FIG.5

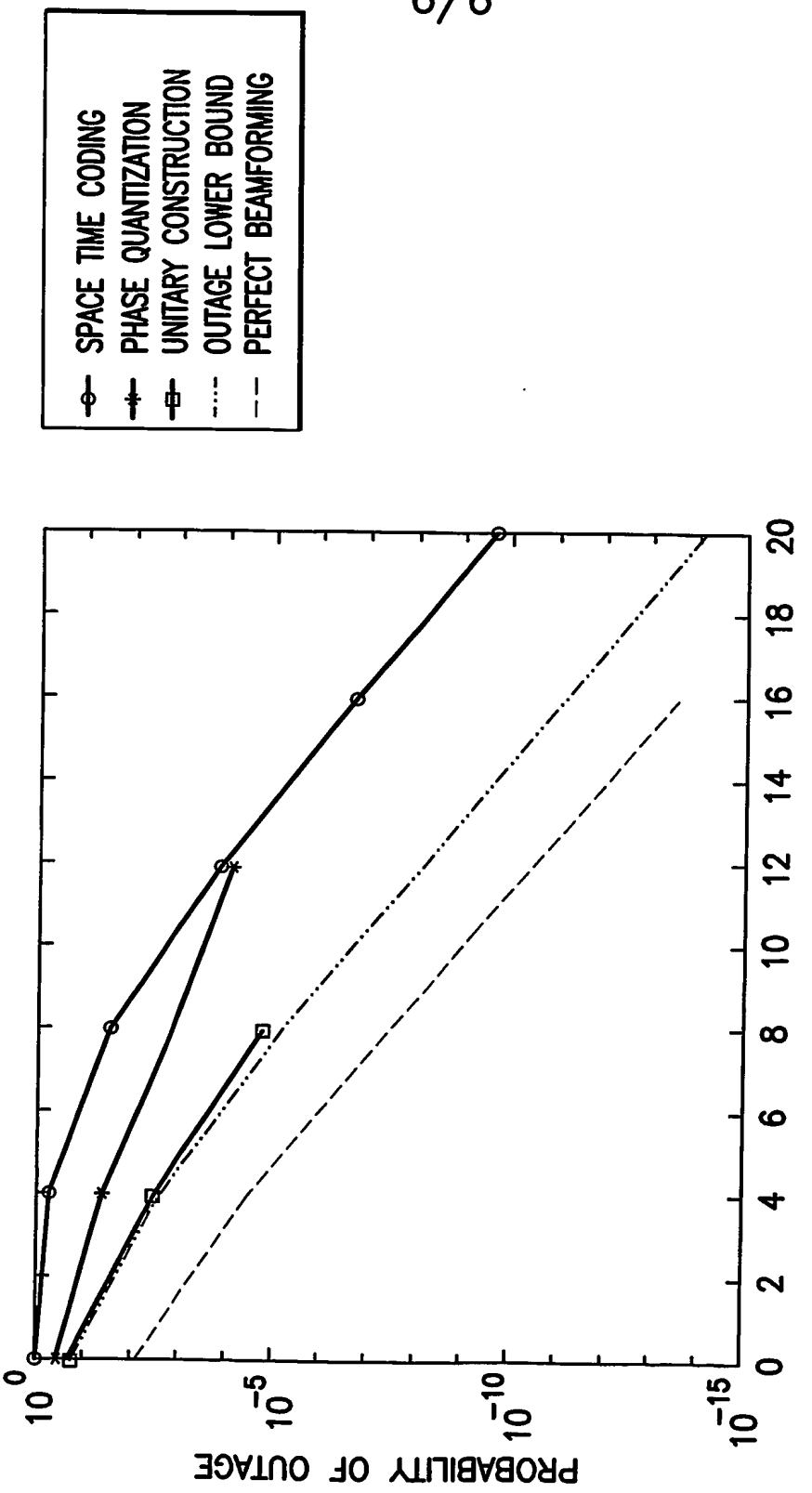
SPACE TIME CODING
PHASE QUANTIZATION
UNITARY CONSTRUCTION
OUTAGE LOWER BOUND
PERFECT BEAMFORMING
PROBABILITY OF OUTAGE
10^{0}
10^{-5}
10^{-10}
10^{-15}
0 2 4 6 8 10 12 14 16 18 20
SNR

FIG.6